3. SAMPLING LOCATION AND FREQUENCY

Aquifer samples will be collected semiannually from the following RWMC area wells: M1SA, M3S, M4D, M6S, M7S, M11S, M12S, M13S, M14S, M15S, M16S, M17S, USGS-127, OW-2, and A11A31 (see Figure 1). All except M17S are outside of the SDA. Appendix A contains the well logs for the INL Site monitoring wells, and Table 4 presents well depths, well screen intervals, and other information about the wells. Not included in Table 4 are the seven area wells, installed and routinely sampled by USGS, that also are used to assess contaminant trends. The seven USGS wells are: USGS-87, USGS-88, USGS-89, USGS-117, USGS-119, USGS-120, and RWMC Production.

Table 4. Specific Radioactive Waste Management Complex well information.

Well	Installation Date[a]	Screened Interval (ft)	Total Depth (ft)	Casing Diameter (in.)	Depth to Water[b] (ft bls)	Estimated Purge Volume[c] (gal)	Flow Rate[d] (gpm)
M1SA	October 1992	608–638	678	6	587.78[b]	221	6[b]
M3S	October 1992	602.8–632.8	660	6	591.35[b]	179	9[b]
M4D	October 1992	798–828	838	6	599.9[e]	1,004	18[e]
M6S	October 1992	642–668	696.5	6	642.37[e]	113	18[e]
M7S	October 1992	598–628	638	6	581.09[e]	250	10[e]
M11S	May 1998	559–569 604–624	624	6	568.52[e]	244	9[e]
M12S	May 1998	528–538 548–568	572	6	538.4[e]	148	12[e]
M13S	May 1998	593.1–603.1 623.1–643.1	645.5	6	603.35[e]	186	9[e]
M14S	May 1998	583.6–604.6 624.6–634.6	645	6	608.3[e]	161	12[e]
M15S	2000	600–620	653	6	597.05[b]	100	6[b]
M16S	2000	578–598	663	6	580.1[e]	321	6[e]
M17S	2000	598–628	665	6	588.26[e]	177	30[e]
OW-2	1993	None[f]	985	6	622.64[e]	1,596	9[e]
A11A31	1993	635–675	683	4	645.25[e]	56	7[e]
USGS-127	2000	496–596	596	6	510.99[e]	374	36[e]

a. Well installation data are from the Hydrogeologic Data Repository Information database.
b. Depth-to-water (feet below land surface [bls]) and flow-rate data represent the May 2003 sampling event.
c. Purge volumes are based on calculating the water column (i.e., subtracting depth-to-water from depth-to-bottom of the well casing). These data are based on three well volumes.
d. Flow rates may vary during purging.
e. Depth-to-water and flow-rate data represent the August 2003 sampling event.
f. There is no screened interval. Well OW-2 was drilled in basalt with the casing to 184 m (603 ft) bls and the open hole from 184 to 300 m (603 to 985 ft) bls.

Additional wells may be brought into the program as needs dictate, and existing wells may be removed if necessary. Well M10S was removed from the WAG 7 sampling network because of problems with the well. Two attempts (Wells M10S-R and S1898) were made to replace Well M10S. Well M10S-R was drilled using muds and additives, which could not be cleared from the well. Well S1898 became unusable when some equipment became irretrievably lodged in it. Currently, neither of the wells has been added to the WAG 7 groundwater monitoring network. If the muds and additives can be cleared from Well M10S-R, and the well yields adequate sample for analysis, it may be sampled. Well S1898 may be used for vapor monitoring.

4. SAMPLE DESIGNATION

A systematic 10-character sample designation code will be assigned to each sample by Sample and Analysis Management (SAM) and will be unique to each sample. SAM ensures that no two samples are assigned the same identification code.

The first three characters identify the project and where the sample was collected for the WAG project. The next three characters designate the sequential sample location for the project. The following two characters designate the sample type (i.e., original or duplicate). The last two characters designate the analysis code, including the analysis and container type. For example, the number "RISK3801RH" from the OU 7-13/14 Groundwater Monitoring Project will indicate the following information:

- "RIS" designates the sample as originating from WAG 7 in support of groundwater sampling
- "K38" designates the sequential sample number
- "01" designates the sample type (i.e., 01 = original sample, and 02 = field duplicate)
- "RH" designates the sample analysis as radiological suite 1.

The SAP tables in Appendix B identify the analyses.

5. SAMPLING PROCEDURES AND EQUIPMENT

Before sampling at the RWMC, the shift supervisor will be notified that sampling will be going on around the facility. Sampling is considered part of routine operations and does not have to be on the plan of the day, except for sampling of M17S within the SDA. A radiological control technician is required to accompany the samplers at the SDA. A prejob briefing is held before the sampling project in accordance with MCP-3003, "Performing Pre-Job Briefings and Documenting Feedback." The rest of this section identifies the appropriate procedures and equipment to be used for the planned groundwater monitoring. Referenced procedures have been approved by the RWMC operational safety board and the nuclear facility manager.

5.1 Groundwater Monitoring

5.1.1 Groundwater Elevations

The water level in each well will be measured before purging using either an electronic measuring tape (Solinst brand or equivalent) or a steel tape measure, as described in GDE-128, "Measuring Groundwater Levels." Measurement of all groundwater levels will be recorded in the logbook to an accuracy of 0.003 m (0.01 ft). The use of automated data loggers for measuring groundwater levels will be implemented as funding becomes available.

Understanding the configuration of the eastern Snake River Plain aquifer's water table is difficult, in part, due to borehole deviation in aquifer wells. A borehole has deviation if it is not quite vertical or straight. Deviation impairs the analysis of water table elevation measurements because it results in measurements that are greater than the true distance from the top of the well to the water table (Rohe and Studley 2003). Conceptual models of the water table configuration are important to environmental management decision-making at the INL Site; these models are based on measurements of depth to the water table taken from aquifer wells at or near the INL Site. When accurate data on the amount of deviation in any given borehole is acquired, then measurements of depth-to-water can be adjusted to reflect the true depth so more accurate conceptual models can be developed. Appendix C, Tables C-1 and C-2 contain current borehole deviation correction factors for the RWMC aquifer monitoring well network. Collection of additional borehole deviation data with gyroscopic logging is planned for complete coverage of the monitoring network to further our confidence in the quality of water level measurements.

5.1.2 Well Purging

All wells will be purged before sample collection following well purging procedures defined in GDE-127, "Sampling Groundwater." During the purging operation, specific conductance, pH, and temperature will be measured using a calibrated Hydrolab or equivalent (Hydrolab 1998). Calibration will be performed according to Technical Procedure (TPR) -6539, "Calibrating and Using the Hydrolab Datasonde Water Quality Multiprobe," to ensure that sensors are functioning properly. If temperature extremes are detected, the field team leader may determine that calibration should be performed more frequently.

Just after purging begins, specific conductance, pH, dissolved oxygen, temperature, and flow rate will be measured, and readings will be recorded at regular intervals thereafter. The flow rate will be noted in the sample logbook. The well will be purged a minimum of three well-casing volumes until the pH, temperature, and specific conductance of the purge water have stabilized or until a maximum of five well-casing volumes have been removed. Purge water is determined to be stable when parameters for three consecutive samples are within the following limits:

- pH: ±0.1
- Temperature: ±0.5°C (33°F)
- Specific conductance: ±10 µmhos/cm.

NOTE: *Dissolved oxygen is a highly unstable water parameter that is easily compromised by fluctuations in the pumping rate. Unlike the parameters above, dissolved oxygen does not have to be stable before sample collection.*

If parameters are still not stable after five volumes have been removed, samples will be collected, and appropriate notations will be recorded in the logbook. If the well is pumped dry, samples will be collected as soon as the well has recovered enough water to fill the required sample bottles.

5.1.3 Groundwater Sampling

Before sampling, all required documentation and safety equipment will be assembled including radios, fire extinguishers, personal protective equipment, containers, and sampling accessories. A prejob briefing will be conducted by the field team leader in accordance with MCP-3003. All sampling personnel will be familiar with this FSP, the QAPjP, and the most current version of the *Health and Safety Plan for the Long-Term Stewardship Sitewide Groundwater Monitoring* (Gurney 2004).

Groundwater samples will be collected in accordance with applicable sections of GDE-127. The SAP tables of Appendix B identify the target analytes, and Table 5 outlines the typical requirements for containers, preservation methods, sample volumes, and holding times associated with the planned analyses. Contract-required detection limits are specified in the QAPjP. These requirements could change as laboratory contracts change.

Table 5. Specific sample requirements for planned groundwater analyses.

	Container			
Analytical Parameter	Volume	Type	Preservative	Holding Time
Volatile organics by gas chromatography/mass spectrometry	120 mL	3–40-mL glass vials	4°C (39°F) and H_2SO_4 to pH < 2, no headspace	14 days
Volatile organics by gas chromatography/mass spectrometry (quality assurance and quality control samples)	360 mL	9–40-mL glass vials	4°C (39°F) and H_2SO_4 to pH < 2, no headspace	14 days
Metals[a]	2 L	2–1,000-mL HDPE bottles	HNO_3 to pH < 2	180 days
Metals-filtered	2 L	2–1,000-mL HDPE bottles	HNO_3 to pH < 2	180 days
Anions[b]	1 L	1–1,000-mL HDPE bottles	4°C (39°F)	28 days
Nitrate-N	1 L	1–1,000-mL HDPE bottles	4°C (39°F) and H_2SO_4 to pH < 2	28 days

Table 5. (continued).

Analytical Parameter	Container Volume	Container Type	Preservative	Holding Time
Bicarbonate	500 mL	1–500-mL HDPE bottles	4°C (39°F)	14 days
Am-241, Cl-36, Np-237, Tc-99, Gross alpha, gross beta, gamma spectroscopy,[c] plutonium isotopes, and uranium isotopes	5 gal	Two 2.55-gal cubetainer	HNO_3 to pH < 2	180 days
C-14, tritium	1 gal	2-1-L HDPE bottles	None	180 days
I-129	2 L	Two 1-L HDPE bottles	$Na_2S_2O_3$, then NaOH to approx. 0.01 M	180 days
I-129 low detection limit[d]	8 L	Two 4-L HDPE bottles	$Na_2S_2O_3$, then NaOH to approx. 0.01 M	180 days

a. Samples are analyzed for Contract Laboratory Program metal analytes.
b. Anion analytes include bromide, chloride, fluoride, nitrate-N, and sulfates.
c. Gamma spectroscopy analytes are specified in the Statement of Work for the laboratory. The analyte list includes the following: Sb-125, Ce-144, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Eu-155, Mn-54, Ru-106, Ag-108m, Ag-110m, Zn-65, and any analytes where the results are greater than 2σ and greater than the minimum detectable activity.
d. Low-level detection limit for I-129 is 0.1 pCi/L.

HDPE = high-density polyethylene

All sampling equipment to be exposed to the water sample will be cleaned in accordance with appropriate procedures. The dedicated submersible pump and sampling manifolds will not require decontamination. Following sampling, all nondedicated equipment that was exposed to the well water will be decontaminated in accordance with GDE-162, “Decontaminating Sampling Equipment,” before storage.

Sample bottles for groundwater samples will be filled to approximately 90–95% of capacity to allow for content expansion or preservation unless it is stated that the sample should have no head space; then the sample bottle is pre-preserved and filled completely. Samples to be analyzed for metals will be both unfiltered and filtered through a 0.45-µm filter. Samples requiring acidification will be acidified to a pH <2 using ultra pure nitric acid.

5.2 Sampling Quality Assurance and Quality Control

For each routine groundwater-sampling event, there are up to four types of field quality control samples, plus performance evaluation samples. The field blanks, trip blanks, and rinsates are aimed specifically at identifying whether contamination was introduced during the sampling process, while the duplicates address a combination of the field and laboratory error, and the performance evaluation samples specifically target the laboratory’s ability to quantify radiological activity in a sample. Because performance evaluation samples are designed to test the laboratory’s performance, sample identities must be concealed from the laboratory. To ensure anonymity of the performance evaluation samples, samples will be assigned a fictitious well name and depth to be used on the chain-of-custody forms and labels. Duplicate samples are used in part to quantify laboratory error. Additional information may be found in the current revision of the QAPjP. Each type of sample is described below:

5.2.1 Field Blanks

Radiological field blanks consist of deionized or ultra pure resi-analyzed water, some of which is poured into the prepared bottle at each sample site. When the last well sample is collected, the field-blank

bottle is full. All other field-blank samples are collected at one location. The purpose of the field blank is to check cross-contamination during sample collection and shipment (one field blank per 20 samples or one per day, whichever is less). In the event of unexpected field sample contamination, field blanks will be used to check chemical preservation techniques and to assess whether contamination could have been introduced at the sampling location. The water used for field blanks, except for VOC field blanks, will be obtained from the water supply at Site or town laboratories. The water used for VOC field blanks will be ultrapure resi-analyzed water.

5.2.2 Trip Blanks

Trip blanks are required for VOC samples only. Organic-free water in a vial is sent from the laboratory to accompany VOC water samples during sampling and shipment processes. This blank is used for checking for cross-contamination during sample handling, shipment, and storage (one per VOC cooler). The trip blank sample will be prepared in an on-Site laboratory before the start of the sampling event using ultrapure resi-analyzed water and will remain unopened throughout the sampling event. Trip blanks will be prepared only for VOC sampling events and used to monitor VOC contamination in the event of unexpected field sample contamination.

5.2.3 Equipment Rinsates

Sample is obtained by rinsing sample collection equipment with analyte-free water, following decontamination, to evaluate field decontamination procedures (one rinsate per 20 samples or one per day, whichever is less). Equipment rinsate samples will be collected at the sample port manifold before decontamination, per sampling event, and before the next use. In the event of unexpected field sample contamination, equipment rinsates will be used to determine whether contamination is from the sampling equipment.

5.2.4 Duplicates

A collocated sample is collected to evaluate cumulative measurement precision associated with field and laboratory operations (one duplicate per 20 samples or one per day, whichever is less).

5.2.5 Radiological Performance Evaluation Samples

Two performance-evaluation samples for radionuclides will be prepared and submitted as double blind with each set of semiannual samples. The performance-evaluation samples will be specially prepared by either the DOE Radiological and Environmental Sciences Laboratory or a certified and approved performance-evaluation sample vendor subcontracted through SAM. The radiological performance-evaluation samples will assess the laboratory's ability to correctly distinguish a nondetection from a detection and to accurately quantify radiological activity in a sample. The samples will remain closed during the entire sampling event. The bottles will be opened only in the laboratory during initial sample preparation and for final analysis. In the event of unexpected field sample contamination, the sealed performance-evaluation samples will be used to determine whether the contamination was introduced at the laboratory.

5.2.6 Organic and Inorganic Performance Evaluation Samples

Performance evaluation samples for organic and inorganic analyses are obtained through Environmental Resource Associates. Environmental Resource Associates is accredited by the National Voluntary Laboratory Accreditation Program as part of the National Institute of Standards and Technology, Technology Services Division, as a supplier of environmental proficiency testing and

quality control standards. National Voluntary Laboratory Accreditation Program provides third-party accreditation to testing and calibration laboratories. Project samplers send sample containers identical to those used in the field to Environmental Resource Associates, and the double blind performance evaluation samples are sent under chain of custody to the project samplers for inclusion with the field samples. Reference values for the samples are sent under separate cover to SAM.

5.3 Corrective Action

Corrective actions will be required whenever an issue is identified, which requires management attention. Issues include failures, malfunctions, deficiencies, defective items, nonconformances, or conditions or actions that may cause adverse operational, environmental, safety and health, or quality assurance consequences. Corrective actions will follow MCP-598, “Corrective Action System,” and issues will be tracked in the Issue Communication and Resolution Environment system.

6. SAMPLE HANDLING AND ANALYSIS

After groundwater samples are collected from the well and preserved, the gloved sampling technician will wipe the sample containers to remove any residual water and will relinquish the samples to the designated sample custodian. The sample custodian will be responsible for ensuring that (1) clear tape is placed over sample container labels, (2) lids are secured, (3) parafilm is placed around lids (excluding volatile organic analysis samples), and (4) samples are properly packaged before shipment. The MCP-1192, "Chain-of-Custody and Sample Labeling for ER and D&D&D Projects," and MCP-9228, "Managing Nonhazardous Samples," contain additional sample-custody information.

6.1 Field Sample Screening Analysis

Groundwater samples have been collected periodically from the RWMC perimeter wells since October 1992. Based on the monitoring results since 1992 (see Section 4 of Holdren et al. 2002) and process knowledge, it is reasonable to expect that RWMC perimeter well samples will be well below the U.S. Department of Transportation (DOT) classification of radioactive material and will not require a field sample gamma radiation screen or an off-Site laboratory shipping screen. Gamma screening will be required for samples collected from Well M17S located inside the SDA until a determination is made otherwise. Purge water requirements for Well M17S are discussed in Section 8.

6.2 Sample Shipping and Laboratory Analysis

Samples will be transported in accordance with the regulations issued by the DOT (49 CFR 171 through 173, 175 through 178, 2004) and the U.S. Environmental Protection Agency sample handling, packaging, and shipping methods (40 CFR 261, 2004). All samples will be packaged and transported in a manner that protects the integrity of the sample and prevents sample leakage. Packaging procedures will vary depending on results of the radiological screening, the suspected sample concentrations, and the DOT hazard classification.

The temperature of one sample cooler per cooler shipment will be observed upon arrival at the analytical laboratory. This cooler will be opened and a thermometer placed inside. When the thermometer equilibrates, the temperature will be recorded in a logbook. Laboratory personnel will communicate the temperature to field personnel to ensure adequate coolant is used during subsequent sample shipments as required.

7. DOCUMENTATION MANAGEMENT AND SAMPLE CONTROL

Section 7.1 summarizes document management and sample control. Documentation includes field logbooks used to record field data and sampling procedures, chain-of-custody forms, and sample container labels. Section 7.2 outlines the sample handling and discusses chain of custody, radioactivity screening, and sample packaging for shipment to the analytical laboratories. The analytical results from these sampling efforts will be documented in a series of technical memoranda that are prepared on an annual basis.

7.1 Documentation

The field team leader will be responsible for controlling and maintaining all field documents and records and for ensuring that all required documents are submitted to the Idaho Cleanup Project Administrative Records and Document Control Center. All entries will be made in permanent ink. All errors will be corrected by drawing a single line through the error and entering the correct information; all corrections will be initialed and dated.

7.1.1 Sample Container Labels

Waterproof, gummed labels generated from the SAP database will display information such as the sample identification number, the name of the project, sample location, and analysis type. In the field, labels will be completed and placed on the containers before collecting the sample. Information about date, time, preservative used, field measurements of hazards, and the sampler's initials will be filled out during field sampling.

7.1.2 Field Guidance Forms

Field guidance forms, which are provided for each sampling event, will be generated from the SAP database to ensure unique sample numbers.

These forms are used to facilitate sample container documentation and organization of field activities, and forms contain information about the following:

- Media
- Analysis type
- Container size and type
- Sample preservation
- Hold times.

7.1.3 Field Logbooks

Logbooks will be used to record information necessary to reconstruct the sampling event and to interpret analytical data. All field logbooks will be controlled and managed according to MCP-1194, "Logbook Practices for ER and D&D&D Projects."

7.1.3.1 Sample/Shipping Logbook. The field teams will document sample information in the logbook. The logbook will contain information such as:

- Physical measurements (if applicable)

- List of quality control samples
- Shipping information (e.g., collection dates, shipping dates, cooler identification number, destination, chain-of-custody number, and name of shipper)
- All relevant team activities
- Problems encountered
- Visitor log
- List of site contracts.

The logbook will be signed and dated at the end of each day's sampling activities.

7.2 Sample Handling and Shipping

All samples will be handled in accordance with MCP-9228. Qualified and approved analytical and testing laboratories will be used to analyze the groundwater samples.

7.2.1 Sample Containers

Analytical samples for laboratory analyses will be collected in precleaned bottles and packaged in accordance with Section 2.3.2.1, "Sample Containers," in the QAPjP.

7.2.2 Sample Preservation

Preservation of water samples will be performed in accordance with MCP-9228. The temperature will be checked periodically before shipment to certify adequate preservation for those samples requiring temperatures at 4°C (39°F) for preservation. Ice chests (coolers) containing frozen reusable ice will be used to chill samples, if required, in the field after sample collection.

7.2.3 Chain-of-Custody Procedures

Samplers will follow the chain-of-custody procedures outlined in MCP-1192. Sample bottles will be stored in a secured area, which is accessible only to the field team members.

7.2.4 Transportation of Samples

Samples will be shipped in accordance with the regulations issued by the DOT (49 CFR 171 through 173, 175 through 178, 2004) and U.S. Environmental Protection Agency sample handling, packaging, and shipping methods (40 CFR 261.4[d], 2004). All samples will be packaged in accordance with the requirements set forth in MCP-3480, "Environmental Instructions for Facilities, Processes, Materials, and Equipment," and PRD-5030, "Environmental Requirements for Facilities, Processes, Materials, and Equipment."

7.2.4.1 Custody Seals. Custody seals will be placed on all shipping containers in such a way as to ensure that sample integrity is not compromised by tampering or unauthorized opening. Clear plastic tape will be placed over the seals to ensure that the seals are not damaged during shipment.

7.2.4.2 On-Site and Off-Site Shipping. An on-Site shipment is any transfer of material within the perimeter of the INL Site. Site-specific requirements for transporting samples within Site boundaries and those required by the Shipping and Receiving Department will be followed. Shipment within the INL

Site boundaries will conform to DOT requirements, as stated in 49 CFR, "Transportation." Off-Site sample shipment will be coordinated with Packaging and Transportation Department personnel, as necessary, and will conform to all applicable DOT requirements.

7.3 Document Revision Requests

Revisions to this document will follow MCP-233, "Process for Developing, Releasing, and Distributing ER Documents (Supplement to MCP-135 and MCP-9395)."

8. HANDLING AND DISPOSITION OF INVESTIGATION-DERIVED WASTE

Containerization of purge water is not required for groundwater outside the SDA, but purge water may not be discharged to the ground within the SDA. Thus, purge water from all wells, except M17S, is discharged to the ground. Purge water from M17S, located inside the SDA, must be initially contained at the wellhead during sampling and transported out of the fenced RWMC area prior to discharge in accordance with MCP-425, "Surveys of Materials for Unrestricted Release and Control of Movement of Contaminated Materials," and the appropriate waste determination and disposition form.

Waste also will include personal protective equipment and miscellaneous sampling materials (e.g., paper towels, plastic bags, and gloves). Based on previous sampling at the RWMC wells, it is not anticipated that any miscellaneous sampling materials will become contaminated. If contaminated, the waste will be bagged, secured with duct tape, and labeled in accordance with instructions from the radiological control technician. The waste can be stored in the RWMC cargo container pending laboratory analyses if necessary. It is expected that the waste will be handled as conditional industrial waste to comply with the waste disposal and disposition form. Free release will be conducted in compliance with MCP-425.

Cold (i.e., nonradiological) waste is sent to the Central Facilities Area landfill or another Site-designated solid-waste landfill. Low-level radioactive waste is stored in the WAG 7 CERCLA (42 USC § 9601 et seq., 1980) storage area in accordance with ICP-MCP-3475, "Temporary Storage of CERCLA-Generated Waste at the INL Site." The waste will be evaluated for additional characterization and managed as low-level waste. Final disposition will be coordinated with Waste Generator Services.

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